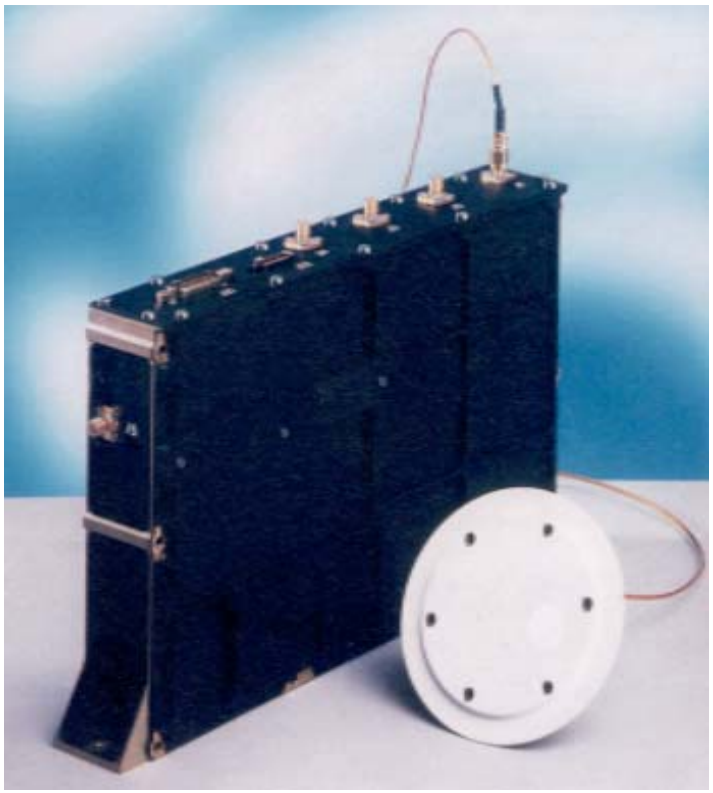
TOPSTAR 3000 D GPS RECEIVER



- General overview
  - PART 1 : Spatial GPS requirements
  - PART 2 : Spatial GPS performances
  - PART 3 : TOPSTAR 3000 D module
  - PART 4 : TOPSTAR 3000 D space qualification
  - PART 5 : Antenna
  - PART 6 : Work plan

PART 1 : spatial GPS requirements

- **AMS-02 requirements**
  - **Position accuracy in LEO (Low Earth Orbit) : few m**
  - **Time transfer or precision accuracy : few μs**
  - **Universal Time Coordinated : translation from GPS Time**
  - **Monitoring degradation C/A (Coarse Acquisition) signal at L1 frequency MHz (conformingly International Telecommunication Union)**

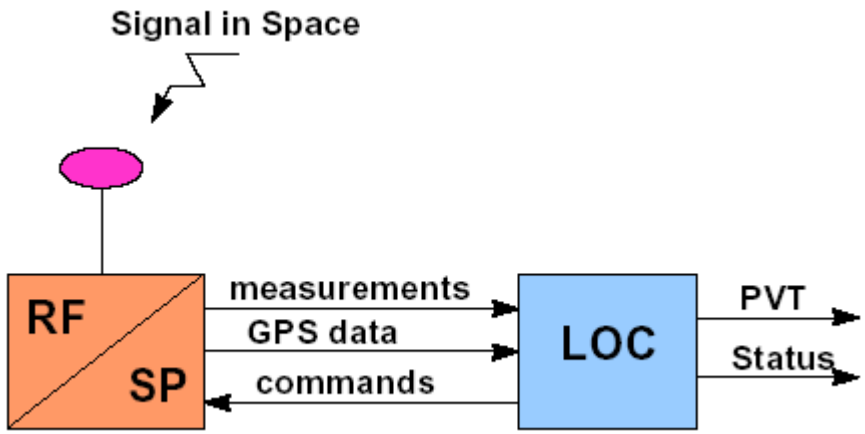
PART 2 : Spatial GPS performances

Performances

- Position accuracy in LEO (Low Earth Orbit) : < 10 m (SA : Selective Availability, obsolete from 2001)
- Velocity accuracy in LEO : < 1 cm/s
- Time transfer accuracy with TCXO (Temperature Controlled Crystal Oscillator) : < 1 μs
- Time transfer accuracy with 0CXO (Oven Controlled Crystal Oscillator) : < 200 ns (not in AMS)
- Cold start & Warm start acquisition : 40 dB.Hz & 35dB.Hz
- After 1st fix acquisition & Code-only tracking : 19 dB.Hz
- Tracking in code and carrier : 29 dB.Hz

PART 3 : TOPSTAR 3000 D Module

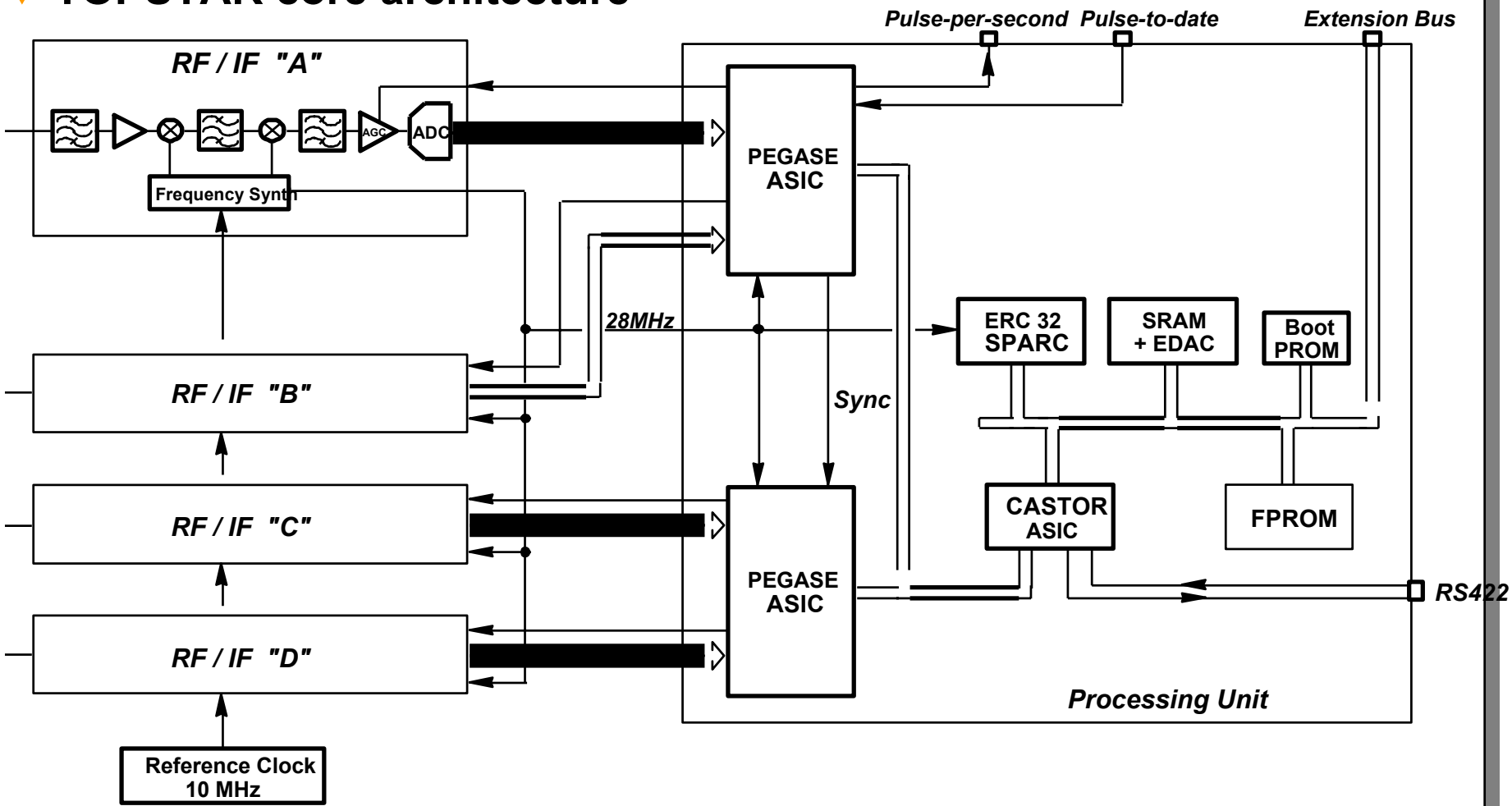
TOPSTAR functional architecture



- RF : radio frequency
- SP : signal processing module
- LOC : localisation module
- PVT : Positioning, Velocity, Time

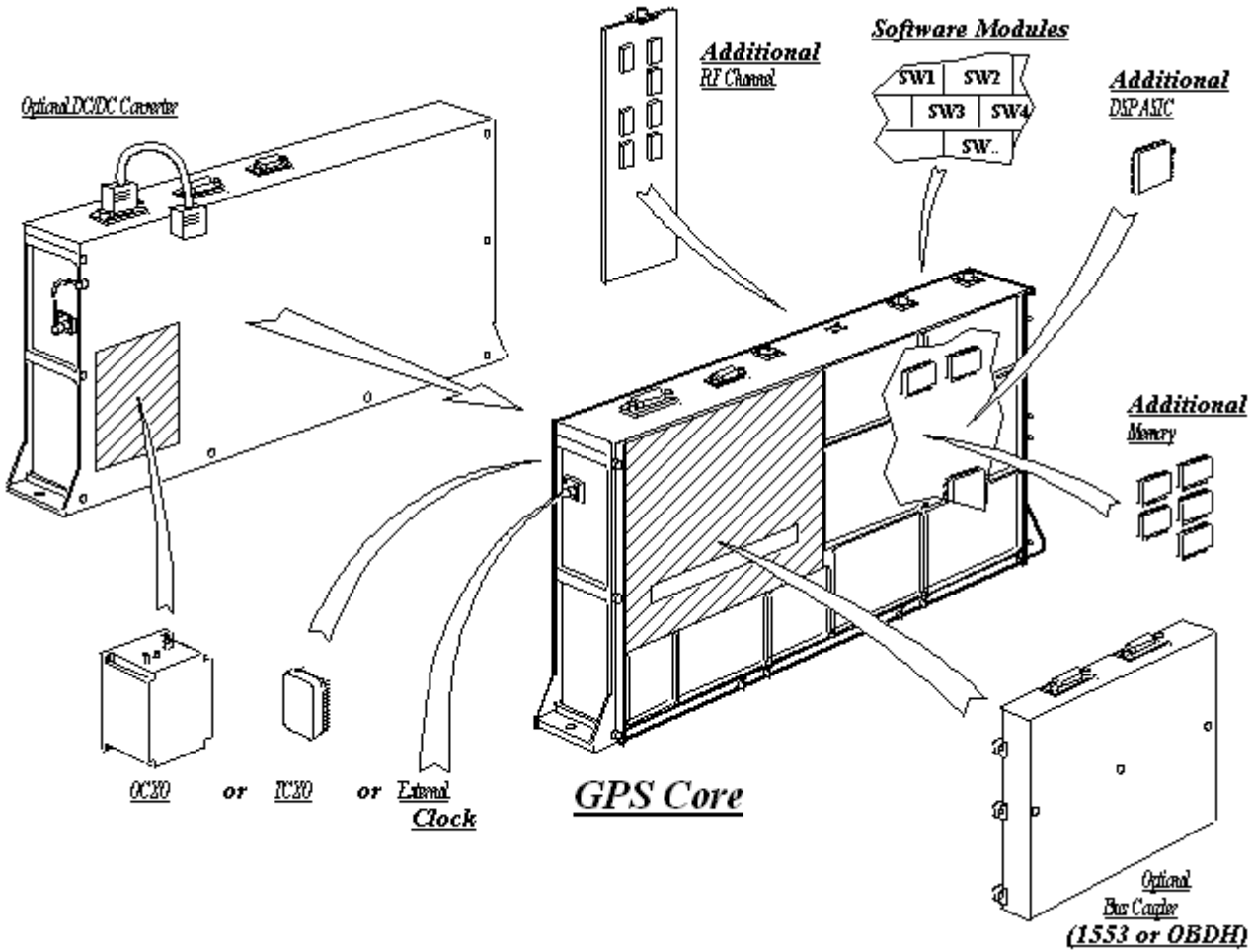
PART 3 : TOPSTAR 3000 D Module

TOPSTAR core architecture



PART 3 : TOPSTAR 3000 D Module

TOPSTAR modularity



PART 3 : TOPSTAR 3000 D Module

TOPSTAR mechanical interfaces

					DOC N° : /							PAGE : /					
TOPSTAR 3000 / DEMETER					Edition	/											
					Date	/											
					Approuv	/											
SUB-SYSTEM : GPS ASSEMBLY				EQUIPMENT MECHANICAL PROPERTIES :							FIGURE :						
Equipment	Nb by sat.	Mass (Kg)			Dimension (mm)			Center of mass (com)			Equipment inertia versus com (Kg m²)			Position of the equipment com in X_S, Y_S, Z_S			Comments
			Typical	Total mass by sat.	L	W	H	l	w	h	I_l	I_w	I_h	X_S	Y_S	Z_S	
Receiver	/	/	1.5	/	276	42	170	/	/	/	/	/	/	/	/	/	

Receiver length value includes fixation legs (receiver length without fixation legs is 245 mm)

Height value does not include connectors height

PART 3 : TOPSTAR 3000 D Module

TOPSTAR thermal interfaces

TOPSTAR 3000 / DEMETER		DOC N° : /					PAGE : /	
		Edition	/					
		Date	/					
		Approuv	/					

SUB-SYSTEM : GPS ASSEMBLY	EQUIPMENT THERMAL PROPERTIES

Equipment	Interface: Conduction: Contact Surface (cm^2)	Conduction: Conductance °C/W.cm^2	Radiation: Radiative Surface (m^2)	Radiation: Emittance ε	Mass kg	Thermal Capacitance J/kg °C	Dissipated Power (W): min	Dissipated Power (W): nom	Dissipated Power (W): max	Thermal conditions (°C): Storage min	Storage max	Qualification min	Qualification max	Acceptance min	Acceptance max	Design min	Design max	Start-up min	Comments
GPS receiver	99	-	0.076	0.89	1.5	866				-40	+70	-20	+60	-20	+55	-15	+50	- 25	
warm up **								8.0	10.3										
operating								6.0	6.5										
stand-by							2.3	2.8	3.1										

Maximal temperature derating for acceptance test conditions is +50°C

(*) Considering that the receiver is " laid down " so that the main side is in contact with the satellite base-plate

(**) Warm-up phase is limited to : 15 seconds after power on, 5 seconds after TC WMODE, 75 seconds per code sections of 128 Kbytes after TC LREPROM

PART 3 : TOPSTAR 3000 D Module

TOPSTAR electrical interfaces

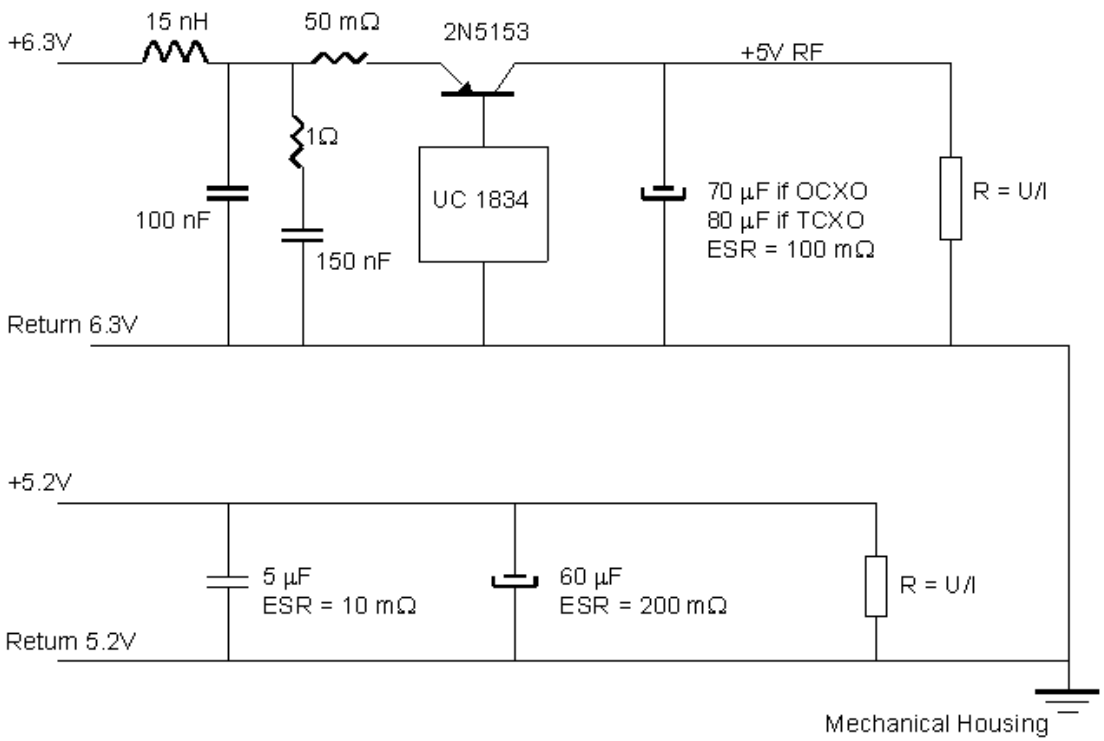
	5VUT	6VRF
Voltage	+ 5.2 V	+ 6.3 V
Accuracy	+/- 4 %	+/- 0.3 V
I min.	0.3 A	0.12 A (*)
I typ.	0.95 A	0.19 A
I max.	1.71 A	0.25 A
Maximum voltage	7 V	10 V
Z impedance	See next figure	See next figure
Rise time (**)	< 20 ms	1 ms < Tr < 20 ms

(*) : When 5VUT is not applied, power consumption is null on 6VRF

(**) Rise and fall time are specified according to 10% - 90% of the voltage value.

PART 3 : TOPSTAR 3000 D Module

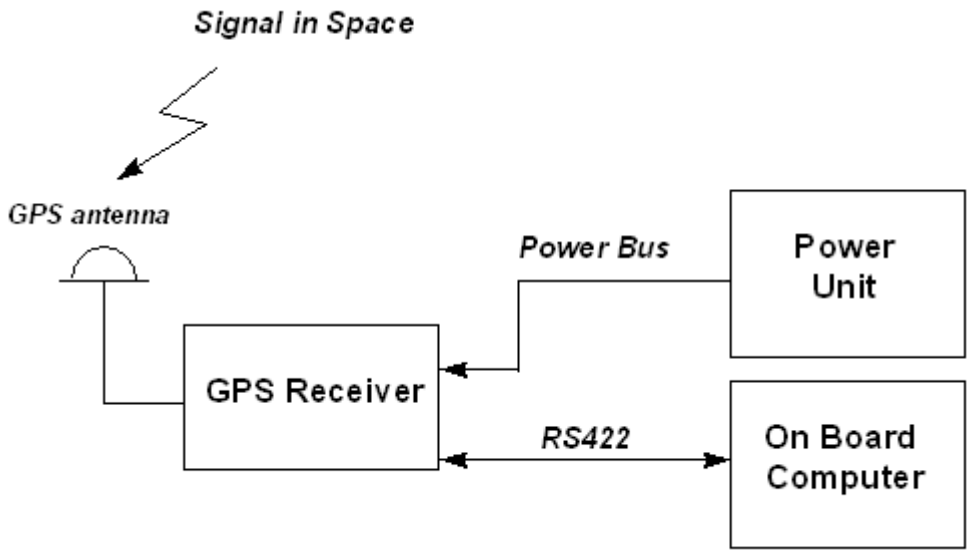
TOPSTAR Secondary Power voltage interface



Detailed Secondary Power voltage interface on +5.2V and +6.3V

PART 3 : TOPSTAR3000 Module

TOPSTAR interfaces overview



The TOPSTAR 3000D GPS receiver is composed of one single GPS core at 10Mhz processing frequency

It interfaces with GPS antenna, secondary voltage lines and on-board computer (through Data Interface serial RS422)

PART 4 : TOPSTAR 3000 D space qualification

TOPSTAR space qualification

- Thermal/vacuum & acceleration/vibration tests ESA qualified
- EEE Parts level is ‘’space-screened’’
- All parts are Latch-up free
- Cumulated dose is over 30 / 50 krads *(100 Krads also available)*
- Architecture is SEU tolerant *(EDAC + Parity Bit)*
- Spaced Qualified manufacturing flow
- Software development Quality level is ESA PSS-05 level B (Essential)

The GPS receiver is manufactured by ALCATEL
(ISO 9001 and AQAP 110 compliant - ESA & CNES qualified)

PART 5 : Spaceborne GPS antenna

The spaceborne GPS antenna 3407-79

Temperature range

Operating temperature : -70°C to + 70°C

Non-operating temperature : -80°C to +80°C

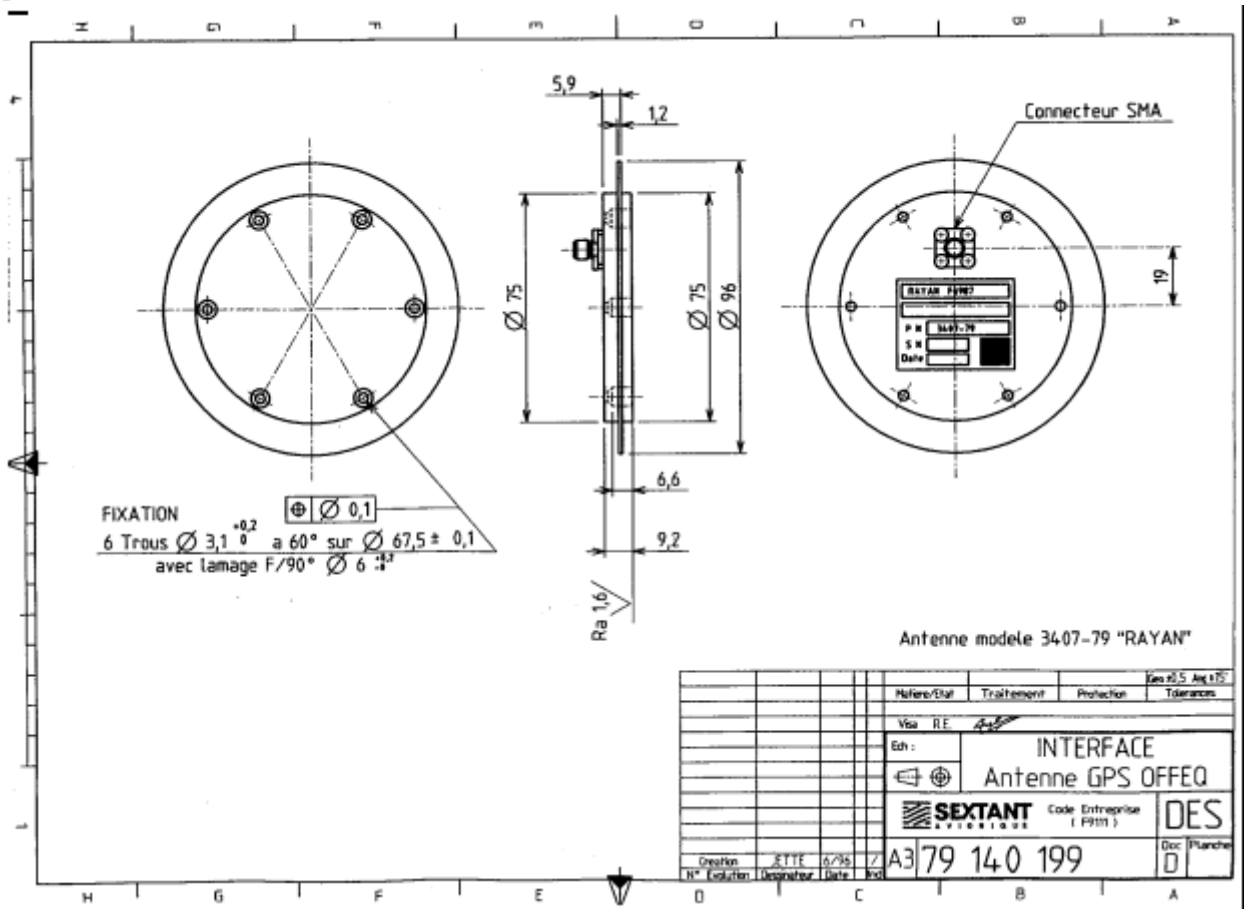
MLI cover

Characteristics

Elements	Heat capacity (J / kg.°C)	Thermal conductivity (W / m.°C)	Density (kg / m3)
Epoxy glass	2093	0.3	~ 1850
Teflon glass	921	0.34	~ 2000
Glue	/	0.35	/
Aluminium	960	150	2800

PART 5 : Spaceborne GPS antenna

The spaceborne GPS antenna 3407-79



PART 6 : Work plan

- **Issues : implementation of TOPSTAR 3000 D in AMS-02**
  - **Practice and test of TopStar 3000 :**

    with Space Alcatel (3 days) in April 2004

    test in magnetic field of few Gauss (1 week) in May 2004 at GAM
  - **Implementation in AMS-02 Trigger and DAQ within AMS (GAM, MIT, ETHZ, ...)**